REMARKS

The present amendment is in response to the Office Action dated March 25, 2008. Claims 1-37 and 39-50 are now present in this case. Claim 38 has been canceled. Claims 10, 22, 29, 39-41, 43, 44, 46, and 50 are amended.

The Examiner is kindly thanked for noting informalities in claims 10 and 40-49. The claim dependency of claim 10 has been corrected and thus provides the proper antecedent basis. Claim 40 has been amended to provide structural limitations requested by the Examiner. Claim 41 has been amended to provide the proper antecedent basis. The claimed dependencies of claims 43 and 44 have been corrected and now provide proper antecedent basis. Claim 46 has been amended to recite a computer readable medium. The applicants respectfully request that the objection to claims 10 and 40-49 be withdrawn.

Claim 50 stands rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. The applicants respectfully traverse these rejections and request reconsideration. Claim 50 has been amended to read more directly on the flow chart of Figure 8 and the accompanying description of Figure 8. It is believed that claim 50 is fully supported by the written description in the application as originally filed. The applicants respectfully request the withdrawal of the rejection of claim 50 under 35 U.S.C. § 112, first paragraph.

Claims 38-40 stand rejected under 35 U.S.C. § 112, second paragraph, as being incomplete for omitting essential structural cooperative relationships of elements, such omission amounting to a gap between the necessary structural connections. The applicants respectfully traverse these rejections and request reconsideration. Claim 38 has been canceled and claims 39-40 have been amended. The applicants respectfully request that the rejection of claims 38-40 under 35 U.S.C. § 112, second paragraph be withdrawn.

Claim 21 stands rejected under 35 U.S.C. § 112, second paragraph, as it contradicts the limitations set forth in independent claim 15 from which it depends. The applicants respectfully traverse these rejections and request reconsideration. The Examiner must consider each claim independently. Claim 21 depends from claim 15 and thus incorporates all elements of claim 15. When one considers the combination of

claims 15 and 21, it is clear there is no contradiction. The method of claim 21 performs a comparison between an estimated amount of patient motion and a correction threshold and performs a three-dimensional image sampling if the estimated patient motion equals or exceeds the correction threshold. The method of claim 21 performs a two-dimensional image resampling in the event that the estimated patient motion is less than the correction threshold. The method of claim 21 further states that no image resampling occurs in the event that the estimated patient motion is less than the corrected threshold by a predetermined amount. Thus, if the estimated patient motion is sufficiently small (i.e., less than the correction threshold be a predetermined amount), no resampling occurs. When considered as a whole, this is not contradictory with the performance of a two-dimensional resampling if the patient motion is less than the correction threshold. Accordingly, the applicants respectfully request that the rejection of claim 21 under 35 U.S.C. § 112, second paragraph be withdrawn.

Claims 1-5, 12-15, 21, 22, 29, 35-41, and 47-50 stand rejected under 35 U.S.C. § 103(a) as unpatentable by Thevenaz et al (IEEE Transactions on Image Processing Vol. 7, No. 1, Jan 1998) combined with U.S. Patent No. 6,266,453 B1 to Hibbard. The applicants respectfully traverse this rejection and request reconsideration. The applicants have discussed the inapplicability of Thevenaz in previous responses. Specifically, Thevenaz discloses an iterative process in which motion estimation is integral to the registration process. As the Office Action admits, at page 6, the iterative process of Thevenaz performs a resampling before any motion estimation is calculated for the first time. The Office Action further admits that Thevenaz does not disclose the use of an MRI system for acquisition of the images. The Office Action cites U.S. Patent No. 6,266,453 to Hibbard et al as disclosing the use of a motion estimation procedure. This is incorrect. Hibbard is directed to techniques for fusing images of different modalities. For example, Hibbard may use X-ray images and MRI images of an anatomical feature and display the multiple modality images on a single display screen. The entire process described in Hibbard et al is directed to techniques for aligning the images from the different modalities. This involves movement, scaling, rotation of images to align the desired anatomical features. (See Abstract.) It does not involve patient motion. Hibbard never even mentions patient motion and provides no

suggestion for any technique to measure patient motion. The sections of Hibbard cited in the Office Action are, in fact, directed to an alignment process for the different image modalities. Nowhere is patient motion measured, or estimated, or even considered by Hibbard. Thus, Hibbard is completely irrelevant to the patient motion estimation process.

The present invention is directed to techniques for a resampling process to compensate for patient motion. As previously noted, there are known techniques for two-dimensional and three-dimensional resampling of medical image data. The inventors in the present application recognize that the wrong resampling technique may actually worsen an image. That is, a three-dimensional resampling may actually result in decreased image readability if it would have been more appropriate to perform a two-dimensional resampling. Furthermore, the inventors recognize that there are some situations in which no resampling is the preferred technique for producing the best quality image. Accordingly, the present invention is directed to techniques for estimating patient motion and, based on the patient motion estimate, selecting the appropriate resampling technique (or no resampling at all). If the patient motion estimate of the present invention indicates that two-dimensional resampling is warranted, any conventional two-dimensional resampling technique may be used. Similarly, if a three-dimensional resampling is indicated by the results of the patient motion estimation, any conventional three-dimensional resampling technique may be used. Thus, the present invention is not directed to resampling techniques per se, but rather a measure of patient motion that may be used to determine whether any resampling is required and, if so, whether a two-dimensional or three-dimensional resampling is the most appropriate. In contrast, Thevenaz is directed strictly to a specific resampling technique that is not dependent on any measure of patient motion. That is, the resampling process occurs automatically without regard to any patient motion or an estimate thereof. The combination of Hibbard with Thevenaz does not overcome this serious deficiency. Hibbard is directed solely to techniques for aligning images of different modalities. While the images may involve in-plane vs. out-of-plane portions of an image, this is not a result of patient motion and no patient motion is estimated by Hibbard at any time. It should be noted that the word "motion" does not

even appear in Hibbard. Thus, the combination of Thevenaz and Hibbard do not teach or suggest the techniques of claims 1-5, 12-15, 21, 29, 35-37, 39-41, and 47-50. The applicants respectfully request allowance of these claims.

Claims 6-11, 16-20, 23-28, 30-34, and 42-46 stand rejected under 35 U.S.C. § 103(a) as unpatentable by Thevenaz et al (IEEE Transactions on Image Processing Vol 7, No 1, Jan 1998) combined with Hibbard regarding claims 5, 15, 22, 29, and 41, and combined further with a journal article by Hill et al.

The applicants respectfully traverse this rejection and request reconsideration. The Office Action notes that the combination of Thevenaz and Hibbard does not disclose specific thresholding parameters and cites Hill et al as supplying those parameters. However, the inapplicability of the combination of Thevenaz and Hibbard has already been discussed in detail above. The addition of Hill to this combination does not overcome the serious deficiency of Thevenaz and Hibbard. As discussed in previous responses, Hill does not teach or suggest an image registration process (e.g., no resampling, 2-D resampling, or 3-D resampling) that are selected on the basis of estimated patient motion. Hill is similar to Thevenaz in that it describes an image registration system, but does not teach or suggest estimating patient motion prior to a registration process. Indeed, patient motion is not even estimated as part of the registration process. Rather, the images themselves undergo a registration process that inherently corrects for patient motion without the need for ever performing an actual estimate of patient motion. In the iterative process described in Thevenaz, the registration and re-registration loop terminates when some error measure is sufficiently small. Similarly, Hill always performs a registration process and thus there is no need to perform the separate task of estimating patient motion prior to performing a registration process, as recited in the claims of the present invention. The present invention is directed to estimating patient motion. Based on the patient motion estimate, the present invention may select not to perform a resampling operation or to perform a two-dimensional resampling or a three-dimensional resampling based on the amount of patient motion with respect to various correction thresholds. Both Thevenaz and Hill teach away from this approach by disclosing a system in which a registration process always occurs regardless of patient motion. Given that Thevenaz and Hill do not

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perform a patient motion estimation process prior to registration (and Hibbard never performs a patient motion estimation), the combination of references clearly cannot teach or suggest thresholds of patient motion estimation that occur prior to a registration process. Therefore, claims 6-11, 16-20, 23-28, 30-34, and 42-46 are allowable over the combination of Thevenaz, Hibbard, and Hill.

In view of the above amendments and remarks, reconsideration of the subject application and its allowance are kindly requested. The applicants have made a good faith effort to place all claims in condition for allowance. If questions remain regarding the present application, the Examiner is invited to contact the undersigned at (206) 757-8029.

Respectfully submitted,

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